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The Neighborhood Alcohol Environment and Injury Risk: A Spatial Analysis of Pedestrian Injury in Baltimore City

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Abstract

Objectives: The purpose of this study was to investigate the contribution of neighborhood disorder around alcohol outlets to pedestrian injury risk.

Methods: A spatial analysis was conducted on census block groups in Baltimore City. Data included pedestrian injury EMS records from January 1, 2014, to April 15, 2015 (n=858), off-premise alcohol outlet locations for 2014 (n=693), and neighborhood disorder indicators and demographics. Negative binomial regression models were used to determine the relationship between alcohol outlet count and pedestrian injuries at the block group level, controlling for other neighborhood factors. Attributable risk was calculated by comparing the total population count per census block group to the injured pedestrian count.

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Ethical approval: This research was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health and deemed non-human subjects research.

Informed consent: This research is not human subjects research, and informed consent was not necessary.

Results: Each one-unit increase in the number of alcohol outlets was associated with a 14.2% (95% CI=(1.099, 1.192), $p<0.001$) increase in the relative risk of neighborhood pedestrian injury, adjusting for traffic volume, pedestrian volume, population density, percent of vacant lots, and median household income. The attributable risk was 10.4% (95% CI=(7.7, 12.7)) or 88 extra injuries. Vacant lots was the only significant neighborhood disorder indicator in the final adjusted model (RR=1.016, 95% CI=(1.007, 1.026), $p=0.003$). Vacant lots have not been previously investigated as possible risk factors for pedestrian injury.

Conclusions: This study identifies modifiable risk factors for pedestrian injury previously unexplored in the literature and may provide evidence for alcohol control strategies (e.g., liquor store licensing, zoning, and enforcement).

Keywords

pedestrian injury; alcohol outlets; spatial analysis; neighborhood disorder

INTRODUCTION

The majority of pedestrian injuries occur in urban areas,[1] yet the distribution of pedestrian injuries and injury risk factors across neighborhoods is not uniform.[2–4] Injury events disproportionately cluster in census tracts with higher rates of unemployment, lower educational levels, lower incomes, and more non-White residents.[4,5] While the unequal distribution of risk factors such as traffic volume[4] and traffic safety infrastructure[6] may account for some of this discrepancy, they may not completely explain the antecedents of the high burden of pedestrian injuries in resource-deprived neighborhoods.

The distribution of alcohol outlets across communities may help explain the inequitable distribution of pedestrian injuries across urban areas.[4] Resource-deprived census tracts and predominantly Black census tracts have significantly more liquor stores per capita than more affluent communities and predominantly White communities.[7,8] Alcohol outlets, particularly off-premise packaged goods stores, are often surrounded by signs of social and physical disorder.[13,14] Physical disorder is the deterioration of the urban landscape—including graffiti, litter, and vacant lots—while social disorder indicates behavior which may be considered threatening, such as verbal harassment on the street or public intoxication.[15] The accumulation of these social and physical conditions around alcohol outlets are often viewed as troublesome and potentially threatening by residents and visitors, who may drive or cross the street unsafely to avoid this undesirable activity.[16–18] No studies have investigated the impact of neighborhood disorder around alcohol outlets on pedestrian injury risk.

We conceptualize the mechanisms by which alcohol outlets and neighborhood physical and social disorder impact pedestrian injury risk using the concept of reciprocal determinism from Social Cognitive Theory—the dynamic interaction of the person, the behavior, and the environment in which the behavior is performed.[19] In this conceptual model, we propose that structural/environmental factors, interpersonal relationships, and individual cognitive and biological events may manifest in pedestrian and driver behavior (Figure 1). The scope

of this study focuses on the structural-level factors which contribute to pedestrian injuries in areas around alcohol outlets.

The purpose of this study was to investigate the impact of alcohol outlets on the neighborhood relative risk of pedestrian injury. We hypothesized that increased numbers of alcohol outlets in a neighborhood would correspond with increased relative risk for pedestrian injuries. We also aimed to investigate indicators of neighborhood physical and social disorder as possible contributors to neighborhood pedestrian injury risk. We hypothesized that neighborhoods with greater physical and social disorder would also experience greater relative risk for pedestrian injury.

METHODS

This research was approved by the Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health.

Data Sources

Pedestrian injury data were gathered through emergency medical services (EMS) records collected from January 1, 2014, to April 15, 2015 (n=848). The Baltimore City Fire Department (BCFD) operates the City's EMS system; as Baltimore City is served by a single EMS system, these data are representative of all EMS calls for pedestrian injuries. Paramedics on the scene confirmed that the injury was caused by a motor vehicle crash. Drug and alcohol use indicators were recorded for only 23% (n=194) of injured pedestrians by EMS staff; positive indicators were present in 6.3% (n=53). Consequently, we were unable to stratify by intoxication status. However, a study of motor vehicle crash victims admitted to a Level-1 trauma center in Baltimore City found that approximately 27% of pedestrians tested positive for alcohol use.[20] We, therefore, assume that a majority of pedestrians included in this study were sober at the time of the crash.

Locations of alcohol outlets in 2014 were obtained through the Board of Liquor License Commissioners for Baltimore City. This study focused on the four licensure classes concerned with sale of package goods for off-premise consumption (n=693). On- and off-premise outlets differentially impact injury risk. Off-premise outlets are more strongly associated with drinking problems, crime, and violence compared to outlets licensed for on-premise consumption only.[10,21] Restaurants, hotels/motels, entertainment venues, and non-profit private clubs were not included in this study as these establishments only allow on-premise alcohol consumption.

Neighborhood data: Assessments of the neighborhood environment were obtained using The Neighborhood Inventory for Environmental Typology (NifETy).[22] NifETy is a standardized inventory designed to assess characteristics of the neighborhood environment related to violence, alcohol, and other drug exposures.[23] For this analysis, we used data collected from July to November 2012, the last year city-wide data collection took place; data collection took place on a random sample of 802 blocks located throughout the city. Full details of the data collection methodology and block selection can be found in Furr-Holden et al.[22]

Vacant lots: Addresses for all vacant lots in 2015 were compiled by the Baltimore City Housing Authority (BCHA); BCHA updates its list of vacant lots twice a month for the purposes of monitoring code violations and streamlining remediation projects.[24] Digital parcel maps of all lots were available through the Maryland State Department of Planning.[25] Vacant lots are an important indicator of neighborhood disorder and have significant effects on community health and safety.[26] A qualitative study of vacant lots' impact on community well-being found that vacant lots overshadowed positive aspects of the community, eroding community cohesion, attracting crime, and increasing residents' fear and anxiety.[18] To calculate percent of vacant lots per census block group, we aggregated the count of vacant lots and the count of all lots to each census block group. We then divided the number of vacant lots by the total number of lots to calculate the percent of vacant lots in each block group.

Pedestrian safety infrastructure: No comprehensive database cataloging Baltimore City's traffic safety infrastructure exists, in part because of the logistical and methodological challenges of maintaining such a database.[27] The Inventory for Pedestrian Safety Infrastructure (IPSI) is a standardized instrument designed to assess the presence of street-level infrastructure for preventing pedestrian injury.[28] The IPSI includes three domains: roadway features, midblock features, and intersection features. The majority of items had good or excellent levels of inter-rater reliability (ICC 0.8), with intersection features showing the highest agreement across raters.[28] The IPSI also has been validated for use with Google Street View (GSV) in place of in-person data collection; GSV images are time-stamped with the month and year an image was processed, and many locations allow the user to travel back in time to every previous image taken at a location. Full details of the IPSI tool creation and validation and data collection methodology can be found in Nesoff et al.[28]

Data collection took place on the same sample of 802 blocks selected by the NifETY sampling methodology. IPSI data were collected from December to February 2017, but IPSI measures were collected for images taken on or before April 2015 to coincide with the dates of EMS data collection.

Traffic volume: Traffic volume is an important predictor of pedestrian injury risk.[4,29] Average Daily Traffic Volume for 2013—the most recent year of data availability—was collected by the Maryland State Highway Administration's Traffic Monitoring System.[30] Traffic counts are recorded at a specific point on the roadway referred to as a "count station" but extrapolated to represent the entire segment or section of roadway by a linear referencing system integration process. This data is then mapped for use as both a point file and a segment file. There are 752 count stations in Baltimore City; 168 (22.3%) count stations located on highways were excluded to create a measure of residential traffic volume. For this study, we used Annual Average Daily Traffic (AADT) so as to include a measure of weekend traffic flow. AADT represents a typical traffic volume count any time or day of the year at a count station. We used the join function in ArcGIS 10.4 to join segment data to each census block group to calculate an average of AADT values for each census block

group. Traffic volume was measured in units of 1,000 vehicles to better facilitate interpretation of coefficients.

Walk Scores for Baltimore neighborhoods were obtained from Live Baltimore.[31] Walk Score is a commercially-available walkability index calculated by mapping out the distance to amenities in nine different categories, including grocery stores, restaurants, shopping, coffee shops, banks, parks, schools, book stores/libraries, and entertainment venues.[32] Walk Score serves as a proxy measure for pedestrian volume as higher Walk Scores are correlated with higher volumes of pedestrians.[33] A high walkability score (on a scale of 0 to 100) signifies that daily errands can be easily performed on foot, while lower scores indicate a neighborhood's automobile dependence.

Demographic variables for each census block group in Baltimore City (n=653), including population totals and median household income, were taken from 2014 Census estimates. [34] Increased population density and median household income have been associated with reduced pedestrian injury risk in previous research.[4,35] Population density was calculated by taking each block group's total population and dividing by the block group's area in square miles. Population density was measured in units of 1,000 residents and median household income was measured in units of \$1,000 to better facilitate interpretation of coefficients.

Measures

Physical Disorder and Social Activity scales: Eighteen binary items from the NifETy, used in previous analyses, were used to classify the neighborhood physical and social environment.[36–39] Physical disorder included broken windows; abandoned buildings; vacant houses; vacant lots; unmaintained properties; broken bottles; graffiti; evidence of vandalism; presence of intoxicated people, signs of using alcohol/drugs or signs of drug selling; syringes or vials; baggies, blunt guts/wrappers or pot roaches; alcohol bottles. Social activity included youth playing, youth sitting in a group, youth in transit, positive adult interactions, adults sitting on steps, adults watching youth. Items were summed to create two scales. Physical disorder score ranged from 0 to 12, with higher scores indicating higher levels of physical disorder (Cronbach's $\alpha=0.79$). Social activity score ranged from 0 to 6, with higher scores indicating higher levels of positive social activity (Cronbach's $\alpha=0.66$).

Intersection and Roadway Safety Infrastructure scales: Two four-item scales were developed from IPSI to measure safety infrastructure at intersections and roadways using Exploratory Factor Analysis (see Nesoff et al. for scale development details).[28] Intersection items include: Number of marked crosswalks at an intersection at the site of a walk signal, stop light or stop sign; number of streets with traffic lights; number of pedestrian crossing signals; number of streets with stop line set back from crosswalk.[28] Roadway items include: Number of street lanes; presence of driveways; on-street parking (parallel or diagonal/back-in parking); presence of bus stops.[28] Items were summed to create two infrastructure scales. Intersection scores ranged from 0 to 21, with higher scores indicating more infrastructure at intersections (Cronbach's $\alpha=0.86$).[28] Roadway scores

ranged from 0 to 8, with higher scores indicating more infrastructure on roadways (Cronbach's $\alpha=0.60$).[28]

Spatial lag of traffic volume: Rather than use the average AADT in a census block group, we estimated the spatial lag. Traffic on one road is spatially autocorrelated with traffic on adjoining roads because traffic flows through adjoining roadways; likewise, traffic in a census block group is spatially autocorrelated with traffic in the adjoining block groups. The spatial lag accounts for traffic volume in the surrounding census block groups, creating a weighted average of traffic volume over the local area. This smooths census block group traffic volume and allows for a more effective estimation of average traffic volume in each census block group.[40]

Data Analyses

Statistical Analysis.—The unit of analysis for all analyses was the census block group ($n=653$). Locations of pedestrian injuries and alcohol outlets were geocoded and mapped in ArcGIS 10.4. To assess the initial hypothesis of a relationship between locations of pedestrian injuries and alcohol outlets, we mapped kernel intensity estimates to assess geographic variability among alcohol outlets and pedestrian injuries and calculated the Cross K function to assess clustering of pedestrian injuries around the fixed locations of alcohol outlets using R 3.3.[41] We then aggregated each variable to the census block group level using the join tool in ArcGIS to compute the count of pedestrian injuries and alcohol outlets per block group so as to assess neighborhood effects.

We performed Poisson regression in R, analyzing the counts of pedestrian injuries per census block group. We first assessed the univariate relationship between count of pedestrian injuries and each covariate of interest. Covariates found to be significant in univariate analysis were then assessed in the multivariate model, adding each control variable in a stepwise fashion. As each control variable was added, we calculated over-dispersion statistics and Residual Moran's I (RMI) to assess residual spatial variation not accounted for by the model's covariates.[41] We also calculated Akaike's Information Criterion (AIC) for each model to select the best fitting and most parsimonious model.[41] Because the best-fitting Poisson model was over-dispersed with significant unexplained spatial variation, we repeated model selection with the negative binomial distribution using the same stepwise system of covariate selection. Negative binomial regression derives as an alternative to Poisson regression that accommodates over-dispersion. We again calculated AIC and RMI to assess residual spatial variation and model fit. The final multivariate model presented here represents the best fitting, most parsimonious model with the least residual spatial variation according to the above criteria.

To calculate pedestrian injury risk attributable to the presence of alcohol outlets, we compared population count per census block group to injured pedestrian count using the attribrisk package in R.[42] In this analysis, every city resident has the potential to experience an injury. The characteristics of the census block in which a person resides influence the injury risk for every city resident. We calculated the baseline injury risk assuming no alcohol outlets in Baltimore City but controlling for population density, percent

of vacant lots, traffic volume lag, median household income, and Walk Score. We next included alcohol outlets and compared the baseline pedestrian injury risk to the outlet-included injury risk.

Missing Data.—We aggregated the physical disorder, social activity, roadway and intersection infrastructure scales, as well as Walk Score, to the census block group level using the join tool in ArcGIS. Because of the small size of census block groups and the financial and temporal limitations of street sampling, 123 (18.8%) block groups lacked measures for physical disorder, social activity, roadway and intersection scales. We performed ordinary kriging to estimate a city-wide map of values for each of the four scales. [41] Using a planometric map of all city streets, we assigned a kriged value for each scale to each street centroid. We then aggregated the centroid values to the block group to calculate the average estimated score for each measure for each block group.

Walk Scores were only available for certain neighborhoods, with $n=33$ (11.9%) neighborhoods missing Walk Scores; Baltimore's neighborhood boundaries also do not align with census block group borders. We used similar methods as described above to estimate a kriged Walk Score value for each census block group.

Sensitivity Analysis.—The downtown neighborhood block group contained 40 injured pedestrians and 32 alcohol outlets; in comparison, the next highest block group contained 13 injuries and 10 outlets. To assess potential biases associated with clustering, we calculated the distance from the geographic centroid of the downtown block group to the centroid of each block group in miles and assessed distance from downtown as a predictor of pedestrian injury. We also excluded the downtown block group to check that the injury-alcohol outlet relationship was not driven by the excessive number of alcohol outlets and injuries in this block group.

RESULTS

Table 1 shows the distribution of selected characteristics across block groups. There was an average of 1.3 ($sd=2.36$) pedestrian injuries per block group. The count of pedestrian injuries ranged from 0 to 40, with 46% of block groups ($n=301$) reporting no pedestrian injuries. The highest pedestrian injury count was reported in the downtown neighborhood with 40 injuries, followed by the adjoining block group with 13 (Figure 2). The downtown block group also reported the highest count of alcohol outlets with 32, followed by two block groups in the southeastern section of the city with 12. Over half ($n=365$) of block groups did not contain an alcohol outlet; on average, there were 1.06 ($sd=2.13$) alcohol outlets per block group.

In the univariate negative binomial regression models, there was a statistically significant relationship between count of alcohol outlets and pedestrian injuries (Table 2, “unadjusted” column). For each unit increase in alcohol outlets, there was a 21.1% increase in pedestrian injury risk (95% CI=(1.157, 1.273), $p<0.001$). Physical disorder score, social activity score, and roadway infrastructure score were not significant predictors of neighborhood pedestrian injury risk in univariate analysis ($p>0.05$) and were excluded from the final model. Percent

of vacant lots was significantly positively correlated with physical disorder score ($r=0.666$, $p<0.0001$) and social activity score ($r=0.510$, $p<0.0001$).

The final multivariate model—count of alcohol outlets, percent of vacant lots, median household income, population density, traffic volume, and Walk Score—was the most parsimonious and best-fitting model (AIC=1898) and exhibited no significant residual spatial variation (RMI=0.0225, $p=0.137$) (Table 2, “adjusted” column). Alcohol outlet count remained associated with pedestrian injury risk after controlling for selected neighborhood measures. Each unit increase in the number of alcohol outlets was associated with a 14.2% increase in neighborhood pedestrian injury risk in the adjusted model (95% CI=(1.099, 1.192), $p<0.001$). In the attributable risk analysis, the pedestrian injury risk attributable to alcohol outlets was 10.4% (95% CI=(7.7, 12.7)) or 88 extra injuries over baseline.

Vacant lots, Walk Score, median household income, population density, and traffic volume were also strong predictors of neighborhood injury risk. Each increasing percent of vacant lots was associated with a 1.6% (95% CI=(1.007, 1.026), $p=0.003$) increase in pedestrian injury risk. Each unit increase in Walk Score—a proxy measure for pedestrian volume—was associated with a 1.8% increase in neighborhood pedestrian injury risk (95% CI=(1.011, 1.025), $p<0.001$). Median household income and population density were protective of neighborhood pedestrian injury risk. Every \$1,000 increase in income was associated with a 0.9% (RR=0.991, 95% CI=(0.988, 0.995), $p<0.001$) decrease in neighborhood pedestrian injury risk. Every increase in 1,000 people per square mile was associated with a 2.1% decrease in neighborhood pedestrian injury risk (RR=0.979, 95% CI=(0.970, 0.989), $p<0.001$). With every increase in 1,000 vehicles, neighborhood pedestrian injury risk increased by 7.6% (95% CI=(1.059, 1.126), $p<0.001$).

In sensitivity analysis, the associations between alcohol outlet count and distance from the downtown outlier block group ($r=-0.295$, $p<0.0001$) and alcohol outlet count and intersection score ($r=0.21$, $p<0.0001$) showed significant correlation and multicollinearity. We substituted distance from downtown and intersection score for outlet count to assess if outlet count was a proxy measure for a different, highly-correlated variable. Both models had significant unexplained spatial variation (RMIs=0.9 and 0.116, $p<0.0001$) and worse model fit (AICs=1974 and 1987). The removal of downtown strengthened the association between alcohol outlets and injury risk (RR=1.168, 95% CI=(1.112, 1.227), $p<0.001$); model fit also improved (AIC=1880). However, RMI became significant (RMI=0.046, $p=0.015$), indicating potential spatial variation unexplained by the covariates.

DISCUSSION

The objective of this study was to explore the relationship between alcohol outlets and neighborhood pedestrian injury risk. Each increase in the number of alcohol outlets was associated with a 14.2% increase in the neighborhood relative risk of pedestrian injuries in the adjusted model. Our findings suggest that there is a strong relationship between neighborhood presence of alcohol outlets and pedestrian injury risk in Baltimore City after controlling for selected neighborhood factors. Substituting traffic safety infrastructure measures for alcohol outlets resulted in significant unexplained spatial variation, indicating

that alcohol outlets may offer a unique contribution to injury risk. These findings are consistent with previous studies of alcohol-involved crashes conducted in several metropolitan areas of varying size across the United States.[11,12]

We also aimed to investigate the contribution of neighborhood physical and social disorder to the relationship between alcohol outlets and pedestrian injuries. Our measures of physical and social disorder were not significant predictors of pedestrian injury, but they were highly correlated with percent of vacant lots in a neighborhood. Each increasing percent of vacant lots was associated with a 1.6% increase in pedestrian injury risk; vacant lots have not been studied previously as predictors of pedestrian injury. Vacant lot remediation has been shown to significantly decrease violent crime.[43] Future research will explore if greening is also associated with reduced pedestrian injury risk.

Although neighborhood disorder measures were not significant predictors, median household income was protective of injury risk—consistent with previous research that demonstrated an inverse relationship between income and average number of injured pedestrians in a census tract.[4] This finding contributes to the literature on the inequitable distribution of pedestrian injuries and injury risk factors across urban areas.[3,5] Future research should investigate the mechanisms by which neighborhood income is protective of pedestrian injury risk.

Limitations

This study is cross-sectional and, therefore, does not allow for discussion of changes in the injury risk environment over time. We were unable to consistently identify alcohol- or drug-involved pedestrian crashes as these indicators were rarely recorded by EMS staff. It is possible that intoxication confounds the relationship between neighborhood pedestrian injury risk and alcohol outlets; this association will be further investigated in future studies. Because the data on neighborhood physical and social disorder were collected several years before the injury data, it is possible that these data do not accurately reflect neighborhood physical and social disorder at the time of a pedestrian-involved crash. However, several studies have suggested that neighborhood disorder is relatively stable, and neighborhood-level changes related to disorder can take 10 to 15 years to manifest.[44,45]

Neighborhoods with more alcohol outlets may be visited by people looking to purchase or consume alcohol, and the high relative risk of pedestrian injury in these neighborhoods may relate to this alcohol-related traffic.[8] As we did not have access to the pedestrians' residential addresses, non-residents may be included in injury counts. This also has implications for the simulated attributable risk, which assumes that the pool of pedestrians capable of being injured are all city residents and that injury risk is static based on the characteristics of their home census block group. Nevertheless, previous studies have shown that the majority of pedestrians are struck within a mile of their home,[46,47] suggesting that injured pedestrians are representative of the neighborhoods in which they are struck. Furthermore, because of the limitations inherent in data collection on pedestrians, calculations of injury risk are often based on estimates from readily-available data sources such as census data or travel surveys.[48] It is also possible that alcohol outlets are located in retail areas with heavy pedestrian traffic. Future research will compare pedestrian injury risk

around alcohol outlets to the relative risk around other, similar retail outlets that do not sell alcohol.

Conclusions

This study reinforces the importance of alcohol outlets in understanding neighborhood pedestrian injury risk and identifies possible modifiable risk factors for preventing pedestrian injury. This research may provide evidence for informing alcohol control policy decisions (e.g., liquor store licensing, zoning, and enforcement). A deeper understanding of the mechanisms by which alcohol outlets impact pedestrian injury risk will be essential for creating targeted, evidence-based safety interventions [9].

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WHAT IS ALREADY KNOWN ON THE SUBJECT

- The distribution of pedestrian injuries across urban neighborhoods is not equal
- Alcohol outlets are associated with increased violent injury and crime

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WHAT THIS STUDY ADDS

- Alcohol outlets in a neighborhood increase the risk of pedestrian injury, even if the pedestrian and/or the driver are sober
- Vacant lots in a neighborhood may be an important predictor of pedestrian injury not explored in previous research

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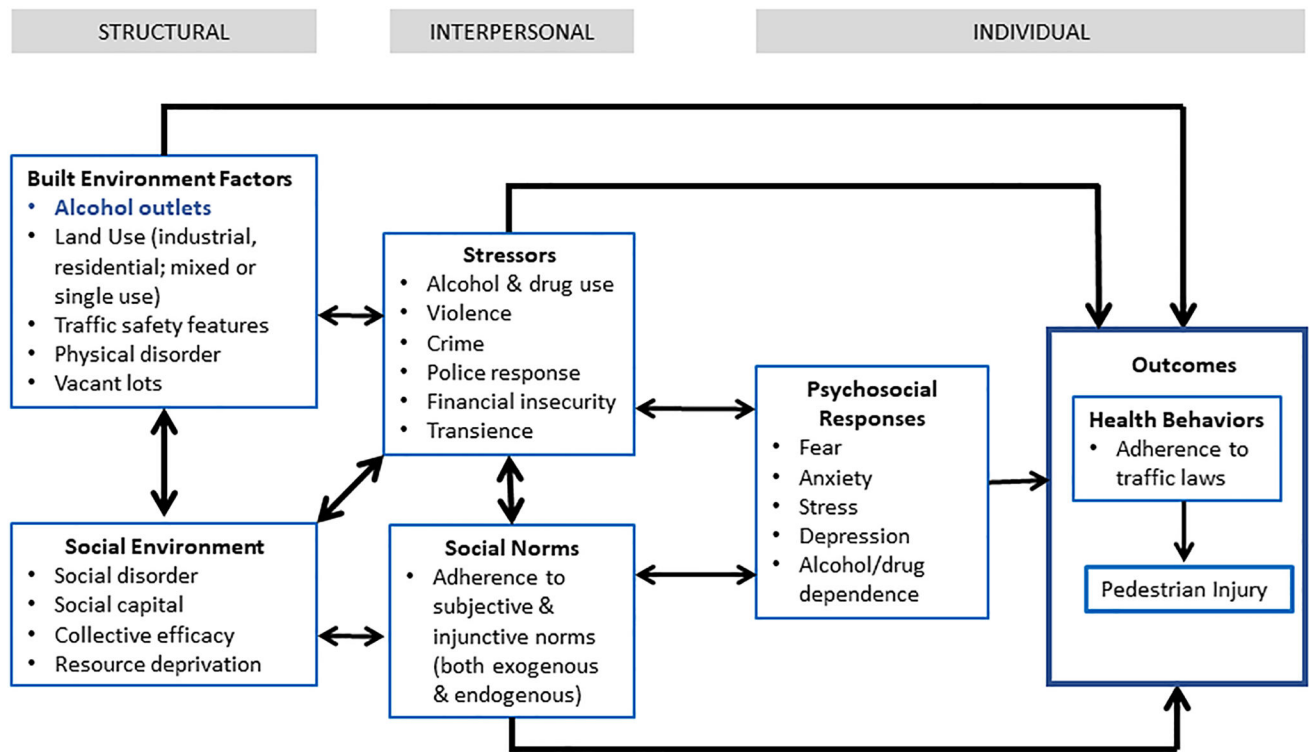


Figure 1. Conceptual model illustrating the mechanisms by which alcohol outlets and neighborhood physical and social disorder impact pedestrian injury risk

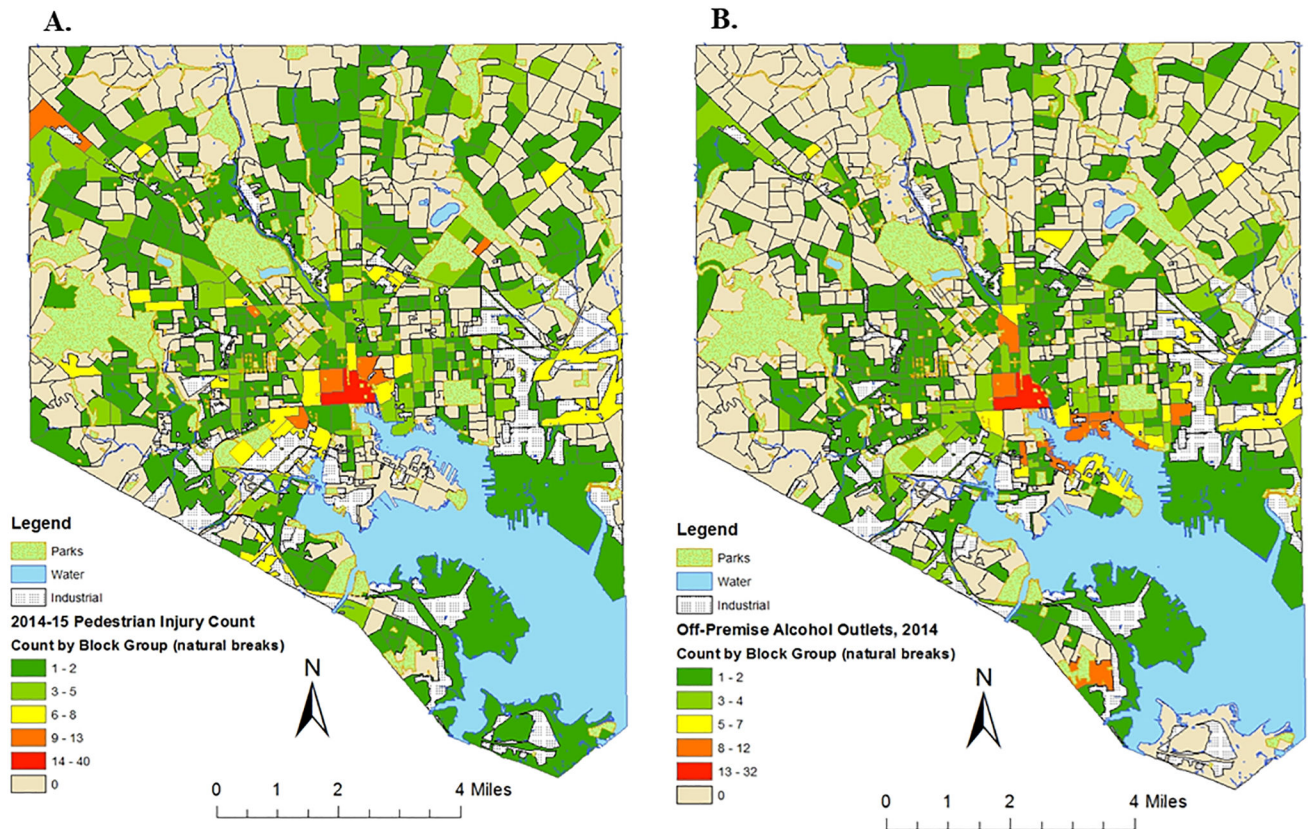


Figure 2.
Distribution of pedestrian injuries and alcohol outlets by census block group for Baltimore City, 2014
Map A: Count of pedestrian injuries from January 1, 2014 to April 15, 2015 by census block group (Data Source: Baltimore City Fire Department)
Map B: Count of off-premise alcohol outlets in 2014 by census block group (Data Source: Baltimore City Board of Liquor License Commissioners)

Table 1.

Description of selected neighborhood characteristics by census block group (n=653)

Variable by Block Group	N	Min.	Max.	Mean	SD
Pedestrian Injury count	848	0	40	1.30	2.36
Alcohol Outlet count	693	0	32	1.06	2.13
Population density (per square mile in 1,000 residents)	--	0	95.16	13.72	9.94
Percent of all lots that are vacant (%)	--	0	49.53	7.02	9.65
Median Household income (in \$1,000s)	--	0	224.43	44.81	27.72
Mean daily traffic volume (in 1,000 vehicles)	--	0.07	33.34	9.71	5.13
Walk Score (range: 0–100)	--	26	97	69.19	14.90
Physical disorder score (range: 0–12)	--	0.21	8.89	4.30	1.92
Social activity score (range: 0–6)	--	0.44	3.02	1.43	0.50
Roadway infrastructure score (range: 0–8)	--	2.86	3.77	3.30	0.18
Intersection infrastructure score (range: 0–21)	--	1.29	10.21	3.84	1.96
Distance from downtown (miles)	--	0	7.5	3.32	1.59

Table 2.

Univariate and multivariate results for negative binomial regression modeling of neighborhood pedestrian injury risk by census block group (n=653)

Variable	Unadjusted			Adjusted*		
	RR	95% CI	p-value	RR	95% CI	p-value
Alcohol outlet count (min: 0 max: 32)	1.211	1.157, 1.273	<0.001	1.142	1.099, 1.192	<0.001
Population density (per square mile in 1,000 residents) (min: 0 max: 95.16)	0.985	0.975, 0.995	0.0122	0.979	0.970, 0.989	<0.001
Percent of all lots that are vacant (%) (min: 0% max: 49.53%)	1.020	1.010, 1.030	<0.001	1.016	1.007, 1.026	0.003
Median household income (in \$1,000s) (min: 0 max: 224.43)	0.992	0.988, 0.996	<0.001	0.991	0.988, 0.995	<0.001
Mean daily traffic volume (in 1,000 vehicles) (spatial lag of traffic) (min: 0.07 max: 33.34)	1.100	1.065, 1.138	<0.001	1.076	1.059, 1.126	<0.001
Walk Score (range: 0–100)	1.028	1.022, 1.035	<0.001	1.018	1.011, 1.025	<0.001
Physical disorder (range: 0–12)	1.045	0.995, 1.096	0.144	--		
Social activity (range: 0–6)	0.985	0.814, 1.192	0.893	--		
Roadway infrastructure (range: 0–8)	0.890	0.524, 1.513	0.713	--		
Intersection infrastructure (range: 0–21)	1.174	1.122, 1.230	<0.001	--		
Distance from downtown (miles) (min: 0 max: 7.5)	0.792	0.749, 0.837	<0.001	--		

* Adjusted for other covariates in the column

Final model fit statistics: AIC=1898; Residual Moran's I =0.0225, p =0.137